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engineering news

School of Engineering

FALL 12

SANTA CLARA UNIVERSITY

DEAN'S MESSAGE

As the academic year gets off to a tremendous start for the School of Engineering with the addition of new faculty members and the creation of the Department of Bioengineering and master's degree program in bioengineering, we celebrate another exciting beginning—the launch of our second century of engineering excellence at Santa Clara University.

Having commemorated our Centennial in style all last year (see our website: www.scu.edu/engineering/100), we look forward with high hopes and great expectations to even better things ahead—and for good reason, as you will read in these pages. Our energy and sustainability programs are blossoming through participation in the U.S. Department of Energy's Solar Decathlon competition, great success in cutting-edge fuel cell technology, and the Latimer Energy Scholars program; our commitment to ethics education continues to grow and thrive, and our students and alumni honor us with their accomplishments and contributions to the field of engineering.

Yes, we are off and rolling on our next hundred years of engineering at Santa Clara. Who knows what great things the future holds?

Godfrey Mungal
Dean
School of Engineering

Photo: Heidi Williams



Civil engineering professors and students research the structural properties of bamboo. From left, Tonya Nilsson, Jay Behel '13, Mey-Ling Leon '13, Mark Aschheim.

ENERGETIC DECATHLETES READY FOR 2013 COMPETITION

With the U.S. Department of Energy's Solar Decathlon approaching, Team Santa Clara is readying for the biennial event taking place in Irvine, California, next October.

Student project manager Jake Gallau '13 likens their preparations to launching a start-up: "Before we start building our solar-powered house, we have the development phase of design, engineering, budgeting, and raising money; and at the end of the day, we have to sell our house to sponsors, judges, and visitors. We're definitely learning as we go—we have electrical engineers working on plumbing and structural engineers becoming experts at architectural drawing; it's a great experience."

After traveling to Spain to check out the European Solar Decathlon earlier this fall, the students are back on campus energetically tackling the engineering innovations that will set Team Santa Clara apart. They have built a prototype of a novel roof connection module system and are expanding on

the groundbreaking bamboo construction techniques that helped SCU to 3rd-place finishes in both the 2007 and 2009 competitions.

"Our goal is to have an all-bamboo framing system for this entry," said Mark Aschheim, chair and professor of civil engineering. "To enable rapid adoption, we are aiming for components that can be substituted for those used in regular light-frame wood construction. Our students and faculty have also designed and will be testing a new variety of bamboo floor joist, a prefabricated load-bearing wall panel, and various versions of shear walls." In keeping with the spirit of the competition, the team expects to use minimally processed bamboo in order to keep the embodied CO₂ down and to maximize the benefits of the environmentally friendly product.

"We're excited to begin construction after the first of the year," said Gallau. To learn more about the team, the house, and sponsorship opportunities, visit <http://sd13.scu.edu>.

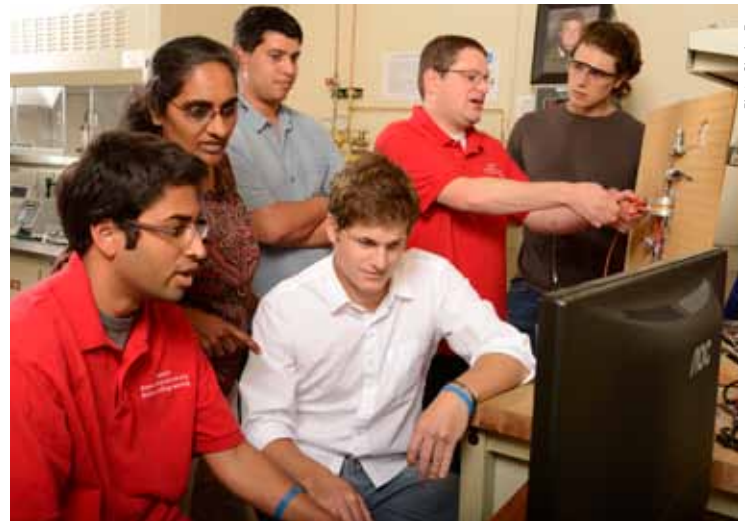
ENGINEERING, COMMUNICATION PAY OFF FOR BRNCOS AT P3 COMPETITION

Competing at P3: People, Prosperity, and the Planet Student Design Competition for Sustainability, Bronco engineers won \$90,000 to develop an innovative fuel cell.

In 2011, teammates Sandeep Lele '12, Ross Pimentel '12, Jeffrey Schwartz '13, Michael Sizemore '12, and Sutyen Zalawadia '12 traveled to Nicaragua with assistant professor Daniel Strickland to gain insight into the needs of the population and the engineering problems their device should address. Tragically, Dr. Strickland, 27, was killed in an automobile accident shortly after their return. Dealing with their loss and grief, the students were determined to continue the research of their beloved professor, working tirelessly to develop a portable, autonomous and unitized regenerative fuel

cell that, coupled with a photovoltaic cell, is capable of continuous, sustainable energy for those in off-grid areas.

In addition to the technical expertise they have gained, Lele reports, "Working on this project has given me more experience in general communication skills—something I believe many people take for granted. By talking with the people in Nicaragua, we learned a few things that we would never have guessed, particularly how they use and maintain their energy system." Communication played a significant role in their success at the EPA-sponsored competition, as well. Team advisor and electrical engineering Associate Professor Shoba Krishnan said, "It is when we go to conferences that we can see how our students excel in communicating difficult



A photo of Dan Strickland is ever present in the lab where (clockwise from left) Sandeep Lele, Shoba Krishnan, Sutyen Zalawadia, Jeffrey Schwartz, Michael Sizemore, and Ross Pimentel work.

technical ideas with such ease. Dan would have been so proud of his team."

"Dr. Strickland was a great mentor and friend to us," said Lele. "Especially on our trip to Nicaragua, it was apparent that

he was very excited about applying his knowledge to develop a technology that could be used in poor, remote communities. It was his dedication and passion that drives us to continue his work."

ENTREPRENEURIAL ENGINEERS

Charles Franz, Greg Method, and Keegan Wada, mechanical engineers from the Class of 2012, took second place in last spring's ASME's IShow, a competition celebrating innovation and the entrepreneurial spirit, with their novel braking device for long trains. To win top honors, they had to demonstrate not only their technical creativity, but also their business acumen as they presented their product before a panel of industry experts, innovators, and venture capitalists.

The team had developed their product as their Senior Design project and during the process started a company called Railwave Systems, LLC. Their Equalizing Distribution Device (EDD) is designed to mitigate in-train forces on long trains (100+ cars) with remote-controlled,

removable valves that can be easily installed on any train's brake pipe system, instantly upgrading the system. With seed money from their win, they are working on a prototype.

Along the way, they have been collaborating with mechanical maintenance managers, engineering managers, locomotive engineers, and others from Union Pacific Railroad, Amtrak and the Richmond Terminal Railroad.

"Integrating the EDD into a modern locomotive is challenging, as is finding a railroad that will let us modify a multimillion-dollar locomotive and take it out with a 100 car freight train," said Franz, "but we have made great strides in the programming and trouble shooting of the wireless communication and we hope to have testing done by the end of the year.



They've been workin' on the railroad: (from left) Keegan Wada '12, Greg Method '12, Charles Franz '12

"A project like this, or any senior design project for that matter, is indispensable for an engineering degree because it's one of the only opportunities students have to actually go through the start-to-finish design process. There are so many fundamental engineering courses that focus on theory (and to some extent application), but not until you go

through a design process can you think, 'Oh what can we use to solve this...how about that fluid flow process we learned eons ago...' Long story short, it's a perfect end to an engineering major to demonstrate how the real world works in the engineering process."

ENERGY SCHOLARS FOLLOW THEIR BLISS

Photo: Hedi Williams



From left: Maggie Jones '15, David Patzelt '14, Jocelyn Tan '15, Kirsten Petersen '13, Peter Stephens '14, Daniel Shull '14

Last January, the School of Engineering initiated a new program, the Latimer Energy Scholars—a select group of undergraduate students who have identified themselves as holding a strong interest in learning about sustainable energy systems, and graduate students who act as mentors. Tim Healy, program director and professor of electrical engineering, reports: “Typically, undergraduates start the program as freshmen, and improve their expertise through the four or more years they are enrolled at Santa Clara University. They study the fundamentals of sustainable energy and carry out practical, hands-on projects of increasing sophistication as they progress through the program. Much of their work is self-guided—they determine which areas interest them most and follow their passion.”

Kirsten Petersen '13 got hooked on the study of renewable energy when she helped assemble solar suitcases at a We Care Solar workshop. “That experience inspired me to get involved with promoting portable solar devices for the developing world,” said Petersen. During the past year, she has been studying various solar technologies and had the opportunity to develop and present a solar technology training talk for incoming Santa Clara students. She later traveled to Uganda as a Global Social Benefit Fellow to share her expertise with social entrepreneurs at Solar Sister. “I had practice on how to present solar technology in a way that makes sense to anyone, regardless of technical background, and with my hands-on experience in the Latimer Energy Lab, I was ready when the opportunity came up,” she said.

Daniel Shull '14 (bioengineering) and Peter Stephens '14 (mechanical engineering) are also focused on solar energy. They have been conducting experiments comparing results from a Solyndra solar module with data from a flat panel of the same material and one of a different material. Maggie Jones '15 and Kerbasi Ugarte '14, both mechanical engineers, have been applying their research on cooling solar panels to development of the PV system for SCU's 2013 Solar Decathlon house.

Mobile innovation is the focus of mechanical engineering junior David Patzelt's research. Professor Radha Basu of our Frugal Innovation Laboratory introduced him to research being conducted on a “CellScope”—a microscope attached to a cell phone for testing of TB and malaria in rural areas, with a particular focus on Third World countries. “When she explained the CellScope,” he said, “I immediately decided that it would be the focus of my summer research. It is important to me that everyone in the world has access to human rights such as healthcare and education. I'm currently familiarizing myself with the advancements being made in the mobile sector to see what I can contribute. Who knows where this research will take me.”

Jocelyn Tan '15 (electrical engineering) also has big aspirations. “My dream is to develop a new or existing form of renewable energy for the future of transportation technology. As a Latimer Scholar, I am exposed to sustainable devices that will soon replace common, yet inefficient, operating systems,” she said. Her work focuses on research and experimentation of a PEM (proton

exchange membrane) hydrogen fuel cell, an instrument that converts chemical energy from hydrogen into electricity through a variety of chemical reactions. Tan adds, “Data collected will be used to understand the cell's internal structure and how effectively it performs under standard conditions.”

The Scholars all agree that the program has surpassed their expectations. “Any area you're interested in, Dr. Healy can help you study; he gives you contacts galore,” said Petersen. Shull adds, “Being able to meet people from industry has been the best outcome of the program. Connections are everything in the business world and we have lots of opportunities to make those connections.”

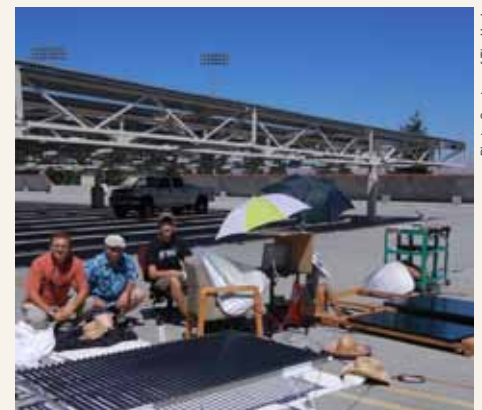


Photo: Courtesy of Tim Healy

From left: energy consultant Greg Smestad '83, Professor Tim Healy, Daniel Shull '14. Shull and Peter Stephens '14 have been conducting experiments on SCU's rooftop parking structure, comparing results of solar energy captured from a traditional flat panel with one incorporating cylindrical modules.

CLAIMING HIS PIECE OF THE PI

Using just one home computer outfitted with four NVIDIA graphics cards, Ed Karrels, computer engineering master's student, has beaten the 2010 record for computing the furthest digits of pi set by a team from Yahoo using 1,000 machines!

It was in Dr. Maria Pantoja's CUDA programming class that Karrels first decided to try to beat the record using NVIDIA's parallel computing platform and programming model to go beyond the 500 trillionth digit. "CUDA is a new form of programming that allows you to tap into the power of the graphics processing unit. It's been quite a challenge—a programming and math challenge as well as a stress test for the computing system," said Karrels, who periodically checked his results against Yahoo's numbers using the School of Engineering's 48 Linux machines.

Applying the Bailey Borwein Plouffe (BBP) formula for computing the nth digit, he was able to start his computations just beyond the 500 trillionth digit, eliminating the need to

manage huge numbers. With his run overlapping the last eight digits of Yahoo's data, the first eight of his matched theirs while extending beyond—producing new, never-computed results. "It was very exciting to get a successful run, and to see my program work. Once I've cleaned up the code a bit, I will post my program and findings online as open source so that others may take it to the next level," he said.

Karrels is a true Silicon Valley success story. After earning a bachelor's degree in computer science in Wisconsin in 1997 and working at Silicon Graphics for two years, he was hired as employee number 56 at Google, retiring five years later, at age 30, when the company went public.

"Ed is an exceptional student," said Professor Pantoja. "His work is extraordinary and he is an inspiration for our students." An avid pilot, bicyclist, traveler, musician, and programmer, Karrels adds, "Nobody needs more than 30 digits of pi, but it was a challenge and it's been fun; it's a nerd thing."



Photo: Nancy Karrels

Following a legendary Silicon Valley tradition, Ed Karrels does great work in his garage.

NEW YEAR, NEW FACULTY!



Yi Fang (left) and Panthea Seperhband

The School of Engineering welcomed two new full-time faculty members this fall. Read about mechanical engineering's Panthea Seperhband and computer science and engineering's Yi Fang on our website:

scu.edu/engineering/enews/2013winter.

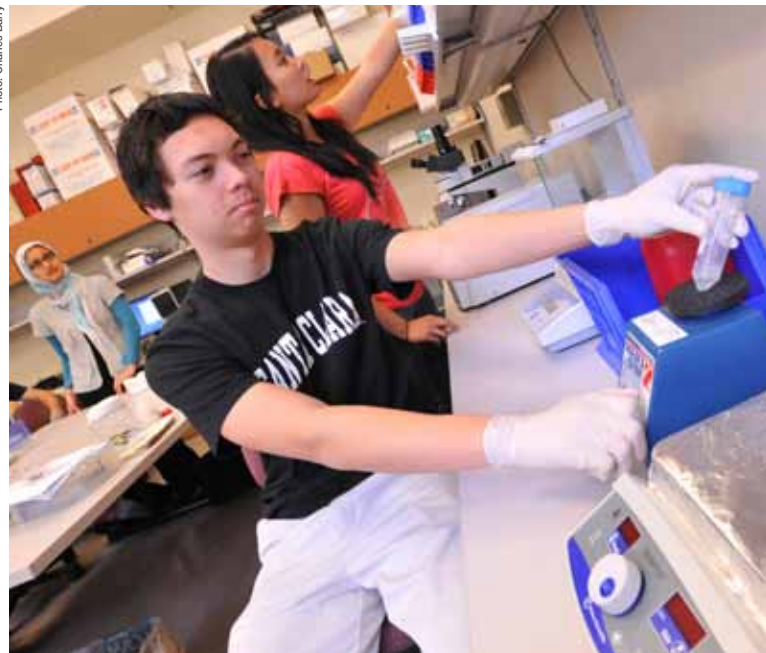
BIOENGINEERING PROGRAM EXPANDS

For a program whose work sometimes focuses on the very small, bioengineering at Santa Clara University is growing very big. “Since the creation of the undergraduate bioengineering degree program in 2009,” said Yuling Yan, chair and associate professor, “we have experienced consistently increasing enrollment as well as strong interest in a graduate degree program.” In response, the University Trustees approved the creation of the Department of Bioengineering (the program had been operating within electrical engineering) and a Master of Science degree program in bioengineering, effective this fall.

“The field of bioengineering and biomedical science has advanced many technologies with the potential to radically change the world of healthcare as well as society’s perspectives on life in general,” said Yan. “But these advances have the potential to negatively impact the lives of human beings the world over if they are not advanced in ethically and socially responsible ways. SCU, as a leader in academic excellence and the promotion of high ethical standards and social responsibility, is uniquely positioned to ensure that this field is populated with people who value both scholarship and service to the underprivileged and impoverished.”

Bioengineering is the fastest growing area of engineering today and Silicon Valley is home to countless medical device and pharmaceutical companies. SCU bioengineering students enjoy internships, field trips, and collaboration with technological innovators based right in our own backyard. In addition to the full-time bioengineering faculty, the program draws adjunct faculty from local medical device and biotech industries and has an outstanding advisory board of industry leaders.

“The growth of bioengineering at Santa Clara University over the past four years has been phenomenal,” said Yan. “With these changes, we are even better able to serve our students and—through them—the world.”



From left: Sarah Ghanbari '11, Cameron Mar '14, and Jennifer Batara '12

SUSTAINING ETHICAL ENGINEERING

When Samiha Mourad, William and Janice Terry Professor of electrical engineering, was developing the School of Engineering's master's program in sustainable energy, she knew ethics would be an important part of the curriculum—not peripherally, but in a way that would further the University's commitment to ethics and excellence in Jesuit education. So she reached out to Shannon Vallor, associate professor of philosophy, whose classes on the philosophy of science and technology and research in ethics of emerging technologies made her the perfect candidate to create a new course, Sustainable Energy and Ethics, offered for the first time this fall.

“This course differs from traditional ethics courses taught within the philosophy department,” said Vallor, “in that it does not focus so heavily on the theory of ethics, but rather on how ethics enter into the practice of engineering in regard to sustainability. The lion's share of the work in this course involves practice in thinking seriously about ethics in a professional setting—getting students in the habit of thinking this way with other engineers as opposed to merely hearing a professor talk about it. Engineers are problem solvers,” she continued, “and in class we examine ethical responses to problems while recognizing that we are not solving and putting away ethics; we must be responding all the time. The students are learning how that kind of problem response works.”

Vallor was eager to take on the challenge of developing and teaching this course for engineers. “Some of the best students in my philosophy courses come from engineering,” she said. “They understand ethics from the point of analysis—they are used to logical assessment of how things hang together. I always wanted more engineers in my courses as they bring a unique way of thinking and often raise the bar for the rest of the class. Now, it's fun to infiltrate their territory!”



Professor Shannon Vallor teaches a new course, Sustainable Energy and Ethics.

***“...we are not solving and putting away ethics;
we must be responding all the time.”***

ALUMNA PROVES SHE CAN TAKE THE HEAT

Photo: Heidi Williams



Robin Senigaglia Beck '77 with the Tau Beta Pi marker on campus; she was president of the honor society's student chapter during her undergraduate days.

As the world watched the Curiosity Rover land on Mars with pinpoint precision last August, Robin Senigaglia Beck '77 breathed a well-deserved sigh of relief. As NASA's Cognizant Engineer for the thermal protection systems (TPS) of the spacecraft, Beck was responsible for the heat shield that allowed the vehicle to enter Mars' atmosphere, with surface temperatures as high as 2,000°C, unscathed with all systems go.

With more than 30 years of experience in the aerospace industry working on ablative reentry material response, Beck was well-prepared for the task of overseeing the team developing, designing, testing, qualifying, and certifying the efficacy of the heat shield.

"Due to the increased size and entry mass over previous missions, the conditions the heat shield would see were beyond anything ever flown to Mars," she said. "When we tested the standard material that had previously flown to Mars, we got catastrophic failure; so with just two years before the originally scheduled 2009 launch, we had to come up with a replacement material and a new design. We chose PICA (Phenolic Impregnated Carbon Ablator) in a tiled configuration and worked closely with both the manufacturer of the tiles and with Lockheed, who built the aeroshell and attached the TPS. In the end, the machining was so exact that no adjustments were necessary—every row of tiles fit perfectly, not one piece needed any adjustment, and the gaps were all within tolerance. The heat shield was beautiful!" Not only that, but Beck's team finished the heat shield in 18 months, in time for delivery for the scheduled 2009 launch.

Three years later, Beck was part of the delegation watching the entry at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California. "I was not nervous at all about the heat shield," she said. "I knew there was more material than what was needed; our test data led me to have full confidence in the heat shield. But still, there were a lot of risky things our team had no control over and I was anxious to see if all the rest of the entry, descent and landing equipment would work. It was so exciting and nerve-wracking, and a relief that no error tones were coming in from the thermal sensors; every tone, every signal came back indicating that the heat shield was doing exactly what it was supposed to. And, of course, everything else worked as well."

Following the successful landing of Curiosity, Beck admits to experiencing a bit of "...post-entry blues. Our baby had been delivered and now it is just a piece of litter," she quips. But now it's back to work on newer, less brittle materials and technology development for men to Mars, heavy masses to Mars, or other planetary missions. It's just all in a day's work for a mechanical engineer.



VISIT OUR CENTENNIAL EXHIBIT

Were SCU engineering students really graded on their table manners at one time? What does Sputnik have to do with Santa Clara Engineering? Where on earth are Bronco engineers taking a Lab-on-a-Chip, and what is that, anyway? Find the answers to these and many more burning questions with a visit to our archives exhibit; open daily now through December 15, 2012.

www.scu.edu/engineering/archives



Santa Clara University
School of Engineering

The Jesuit University in Silicon Valley

Santa Clara University
500 El Camino Real
Santa Clara, CA 95053

